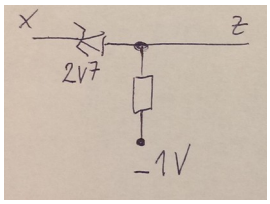
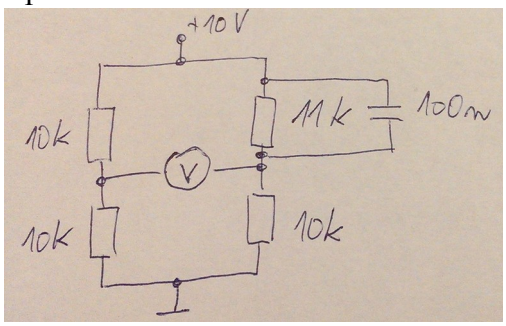
1. pismeni izpit iz Elektronike (FMT)
3. julij 2017

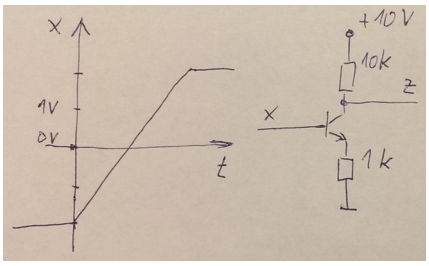
1. Na vhodu *x* se napetost počasi spusti od 4V do -4V. Narišite v isti graf poteka napetosti *x* in *z*.



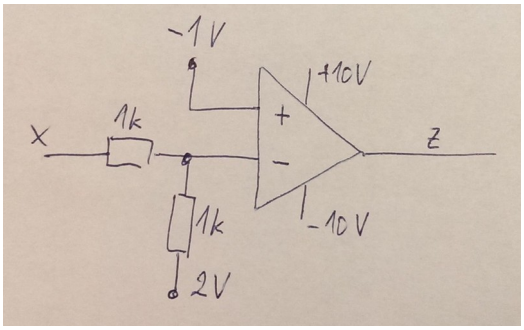
2. Koliko pokaže merilnik napetosti v merilnem mostiču na sliki?



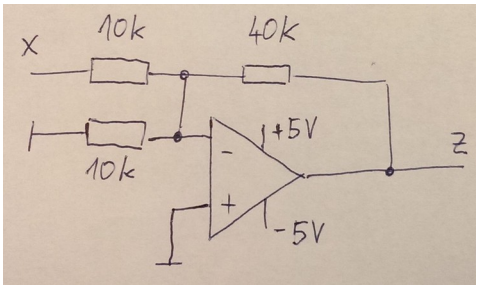
3. Narišite graf poteka izhodne napetosti *z*.



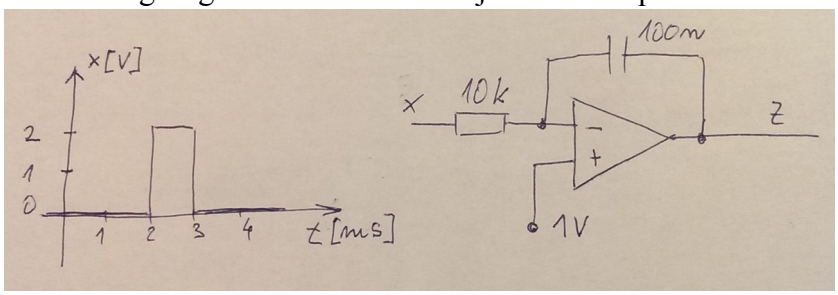
4. Za katere vrednosti napetosti *x* je napetost *z* manjša od -2V?



5. Kakšno je ojačenje in kolikšna je največja amplituda vhodnega signala *x*, pri kateri izhod *z* še ni popačen?

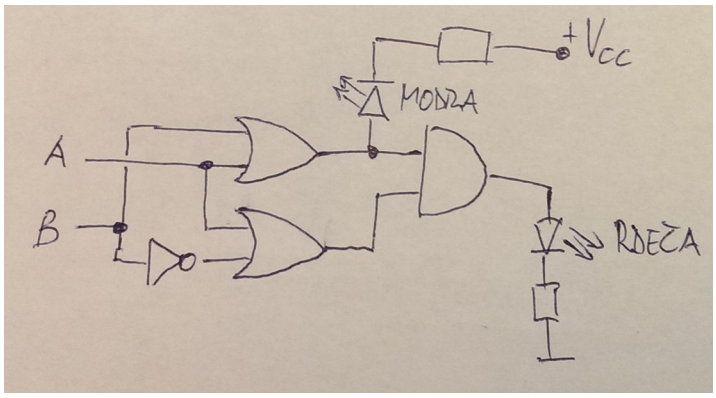


6. Narišite potek izhodnega signala *z*. Kondenzator je v začetku prazen.

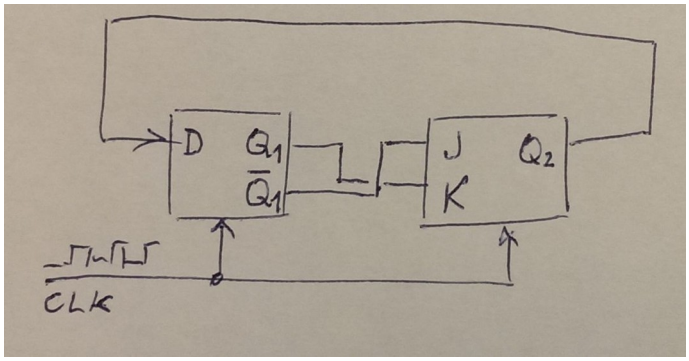


7. Narišite shemo ojačevalnika, ki signale do frekvence 10k s^{-1} ojačuje z 20dB, pri višjih frekvencah pa ojačenje pada s strmino -20dB na frekvenčno dekado.

8. pri katerih kombinacijah A in B sveti modra LED in pri katerih sveti rdeča LED?



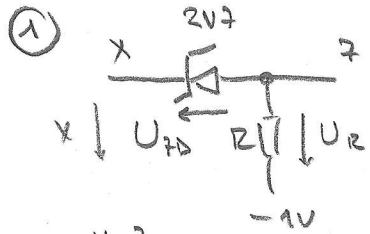
9. Narišite diagram stanj Q_1,Q_2 za tale avtomat.

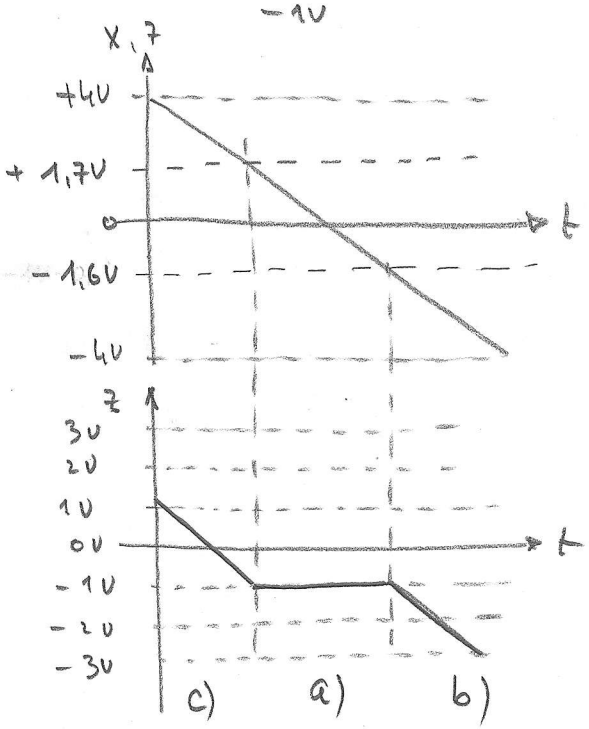


10. S čim manjšim številom logičnih vrat vrste IN/ALI/NE realizirajte izraz $A \cdot B + A \cdot \overline{C} + B \cdot \overline{A} + \overline{A} \cdot B + A \cdot C$.

Časa za reševanje je 60 minut, zapiskov ne uporabljamo. Srečno! M.V.

1. pisni izpit iz elektronike, FMT, 3.6.2017

① 



a) ZD ne prevaja ⇒ skozi R ni toka
$Z = -1V$

b) ZD prevaja v prevodni smeri,
če je napetost na njej $U_{ZD} > 0{,}6V$
takrat je $X + U_{ZD} < -1V$
$X < -1V - 0{,}6V$

c) ZD prevaja v zaporni smeri,
če je napetost na njej $U_{ZD} < -2{,}7V$
takrat je $X + U_{ZD} > -1V$
$X > -1V + 2{,}7V$

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a) $Z = -1V$

b) $Z = X + 0{,}6V$

c) $Z = X - 2{,}7V$

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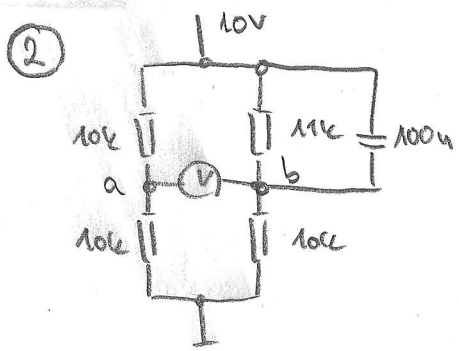
② 

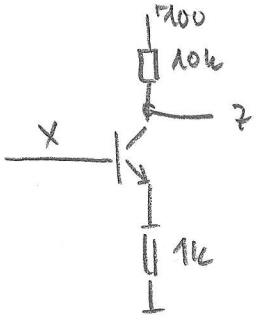
Dc razmere ⇒ 100n ne vpliva

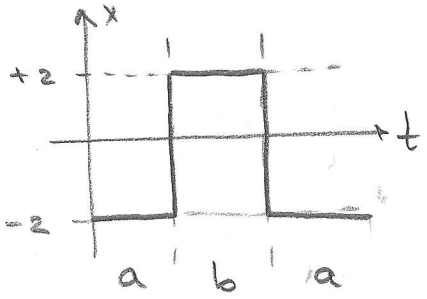
$$a = 10V \frac{10k}{10k + 10k} = 5V$$

$$b = 10V \frac{10k}{10k + 11k} = 10 \cdot \frac{10}{21} = 4{,}762V$$

$$U_{VM} = b - a = 238\,mV$$

③





a) izh. napetost < 0 ⇒ tranzistor ne prevaja
tok skozenj je nič
padec napetosti na $R = 10k = $ nič
$Z = +10V$

b) izh. napetost = 2V ⇒ tranzistor prevaja

$U_{BE} = 0.6V$

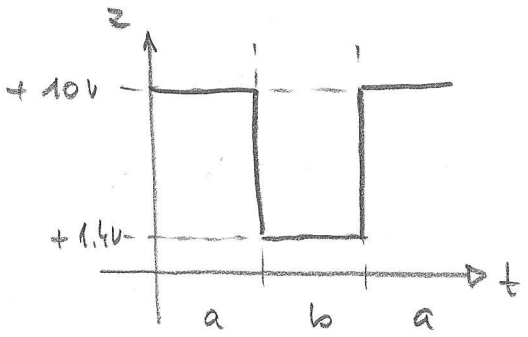
$U_{1k} = X - U_{BE} = 2 - 0,6 = 1,4V$

$I_{1k} = \frac{U_{1k}}{1k} = 1,4mA$

ta tok priteka skozi $R = 10k$

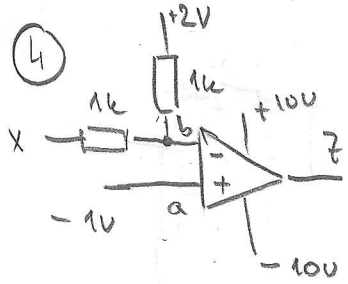
$U_{10k} = I_{1k} \cdot 10k = 14V$!

prevelik, tr je lahko največ polovična odpnt telo, da je napetost na njem skoraj 0



Zato: $Z = 1,4V$

④



$z = G \cdot (a - b) \quad ; \; G \to \infty$

$\text{in } z = \begin{cases} +10V \\ -10V \end{cases}$

b: $\frac{b - X}{1k} + \frac{b - 2V}{1k} = 0$

$2b = 2V + X$

$\boxed{b = 1V + X/2}$

če je $b < a \Rightarrow z = +10V$

$\boxed{b > a \Rightarrow z = -10V} \Rightarrow 1V + \frac{X}{2} > -1V$

$\frac{X}{2} > -2V$

$\boxed{X > -4V}$

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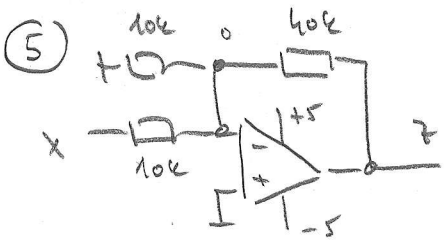
⑤



izhod z gre lahko do največ $\pm 5V$

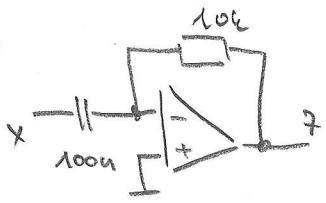
ojačenje: $z = -X \frac{40k}{10k} = -4X \Rightarrow$ ojačenje $= -4$

vhodni signal, ki je večji od

$X_{max} > \frac{5V}{4} = 1.25V$

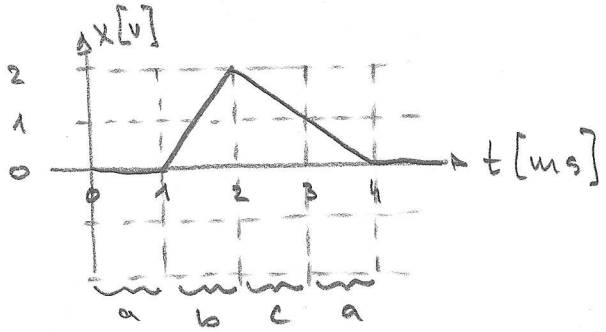
povzroči, da se z zalili v $\pm 5V$, zato je popačen

(6)



vezje je diferenciator z idealnim OP

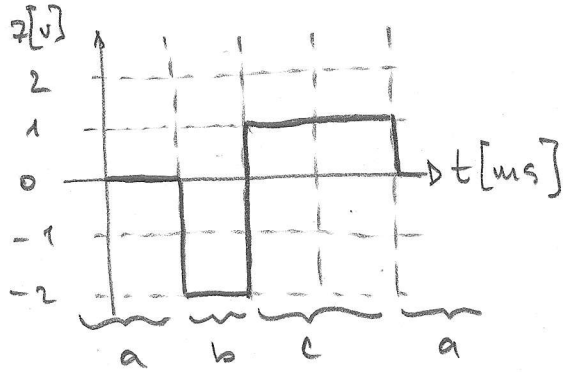
$$z = -RC\frac{dx}{dt} \quad ; \quad RC = 10^{1}\cdot 10^{-7} = 1\,ms$$



a) $\frac{dx}{dt} = 0 \Rightarrow z = 0$

b) $\frac{dx}{dt} = \frac{2V}{1ms} = 2000\ V/s$

$z = -10^{-3}\cdot 2\cdot 10^{3} = -2V$

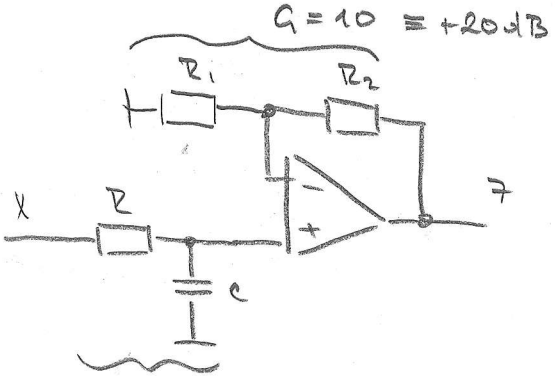


c) $\frac{dx}{dt} = \frac{-2V}{2ms} = -1000\ V/s$

$z = -10^{-3}\cdot(-10^{3}) = 1V$

---

(7)



RC, prelomna $f = 10k$

RC: $\omega_p = \frac{1}{RC} = 2\pi\cdot 10^{3}$, izberi $C = 10nF = 10\cdot 10^{-9}F$

potem je $R = \frac{1}{2\pi C\cdot f_p}$

$$R = \frac{1}{2\pi\cdot 10^{-8}\cdot 10^{4}} = \underline{1{,}59k\Omega}$$

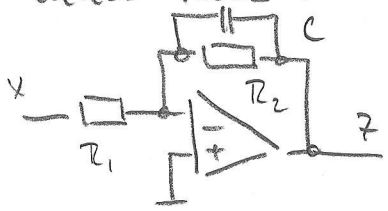
ojačevalnik: $G = 10$

$G = 1 + \frac{R_2}{R_1} \Rightarrow R_2 = 9R_1$

na primer

$R_1 = \underline{10k}$, $R_2 = \underline{90k}$

lahko tudi:



$$\frac{X}{R_1} + \frac{Z}{R_2} + \frac{Z}{\frac{1}{Cp}} = 0$$

$$Z\left[1 + R_2 C p\right] = -X \frac{R_2}{R_1}$$

$$Z = -X \frac{R_2}{R_1} \frac{1}{1 + R_2 C p} \Rightarrow T(i\omega) = \underbrace{-\frac{R_2}{R_1}}_{\text{ojačenje}} \underbrace{\frac{1}{1 + i\omega R_2 C}}_{\text{mejna } f}$$

ojačenje 10

$\frac{R_2}{R_1} = G = 10 = 20\,dB \rightarrow$ na primer

$R_1 = \underline{1k}$, $R_2 = \underline{10k}$

mejna frekvenca iz $R_2 C$

$$f_p = \frac{1}{2\pi R_2 C} \Rightarrow C = \frac{1}{2\pi R_2 f_p} = \frac{1}{2\pi \cdot 10^4 \cdot 10^4}$$

$$C = \underline{1{,}59\,nF}$$

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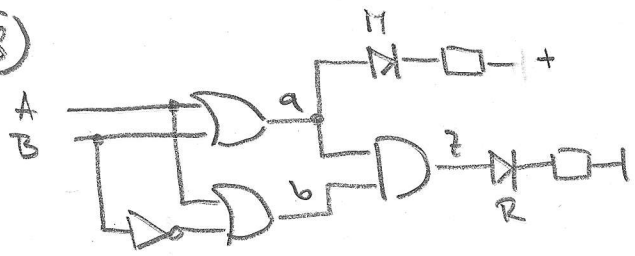
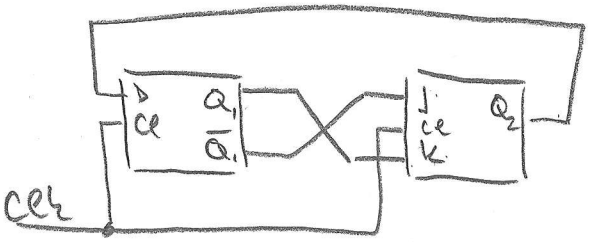
(8)



A	B	a	b	Z	
0	0	0	1	0	
0	1	1	0	0	
1	0	1	1	1	← sveli R
1	1	1	1	1	←

ugotovitev: M ne more sveliti, saj je lahko polarizirano le v zaporni smeri. R sveli, ko je $Z = 1$

(9)



J	K	Q^+
0	0	Q
0	1	0
1	0	1
1	1	$\bar{Q}$

$Q_1 Q_2$

---

(10)

$$Z = AB + A\bar{C} + B\bar{A} + \bar{A}B + AC = A + B$$

$A(\bar{C} + C)$

$\Downarrow$

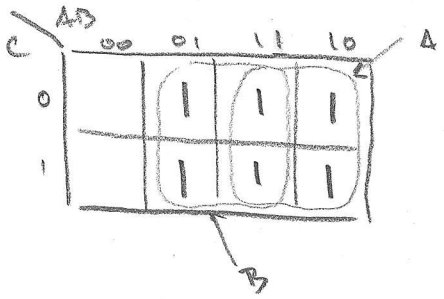
A

$A(B + 1)$

$\Downarrow$

A

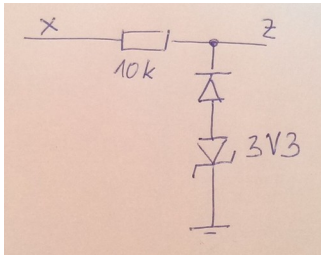
lahko tudi



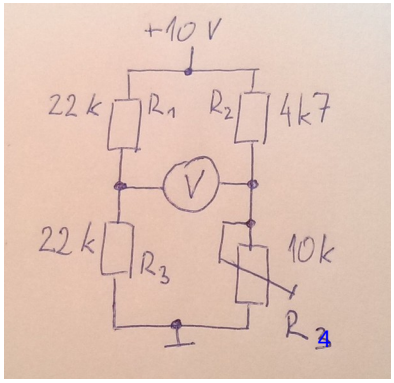
$Z = A + B$

2. pismeni izpit iz Elektronike v fiziki (FMT)
25. avgust 2017

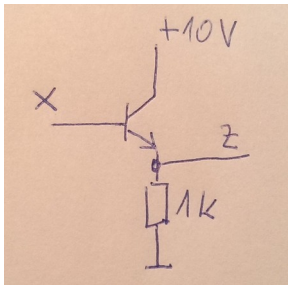
1. Na vhodu x se napetost počasi dvigne od -5V do 5V. Narišite v isti graf poteka napetosti x in z.



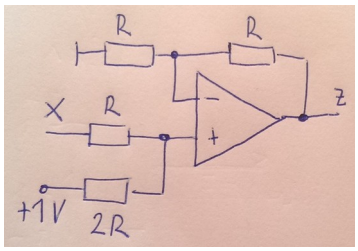
2. Koliko kaže merilnik napetosti v merilnem mostiču na sliki? Potenciometer R_3 je v srednji legi.



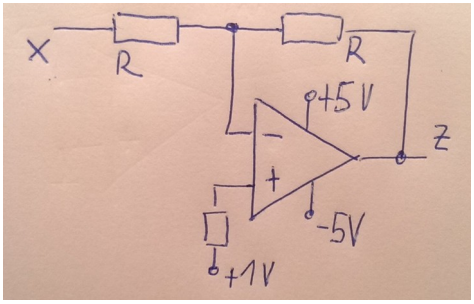
3. Narišite grafa poteka napetosti x in z, ko se x postopno poveča od -1V do 3V.



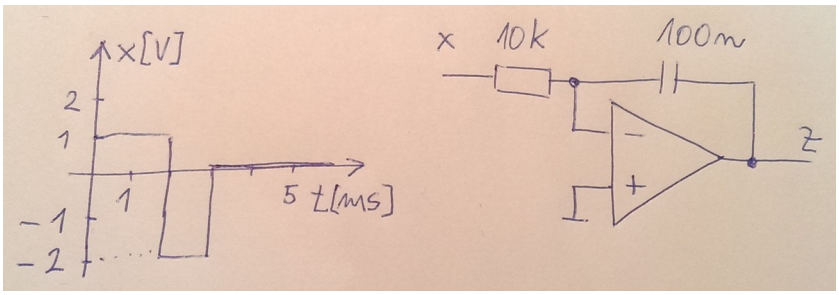
4. Za katere vrednosti napetosti x je napetost z negativna?



5. Kakšno je ojačenje in kolikšna je največja amplituda vhodnega signala x, pri kateri izhod z še ni popačen?

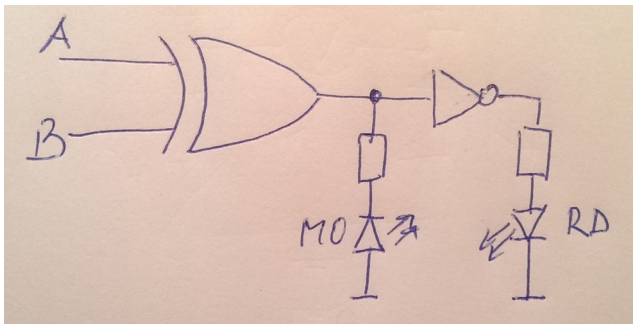


6. Narišite potek izhodnega signala *z*. Kondenzator je v začetku poskusa prazen (to je, med njegovima priključkoma je napetost nič).

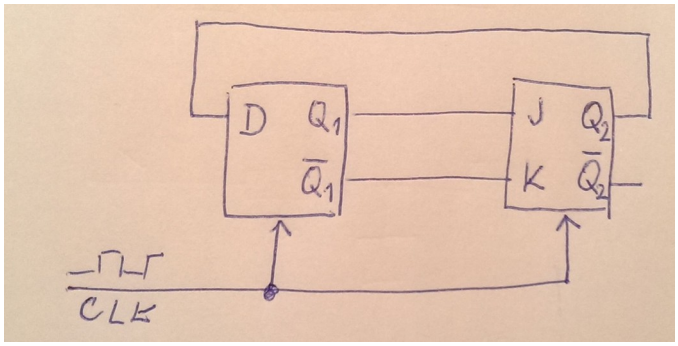


7. Narišite shemo ojačevalnika z ojačenjem 14 dB. Ojačenje naj bo pozitivno. Uporabite en sam operacijski ojačevalnik in poljubno število uporov po 10 kΩ.

8. Pri katerih kombinacijah *A* in *B* sveti modra LED in pri katerih sveti rdeča LED?



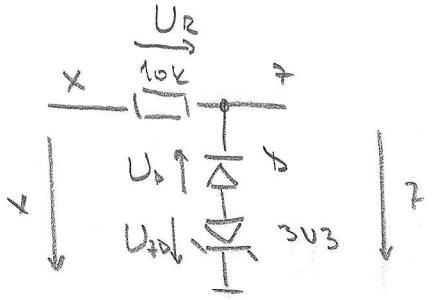
9. Narišite diagram stanj Q_1,Q_2 za tale avtomat.



10. S čim manjšim številom logičnih vrat vrste IN/ALI/NE realizirajte izraz $(P + \overline{P}) \cdot (P + Q \cdot \overline{P} + Q + P \cdot Q)$.

Časa za reševanje je 60 minut, zapiskov ne uporabljamo. Srečno! M.V.

2. pisni izpit FMT, 25. 8. 2017

① 

a) dioda D ne prevaja $\Rightarrow$ tok skozi $R = 10k = 0$ in $\underline{Z = X}$

b) dioda D prevaja $\Rightarrow$ skozenjo teče tok, ki teče tudi skozi ZD 3V3, takrat je na ZD napetost -3,3V
izh. napetost $Z = U_{ZD} - U_D = -3,3V - 0,6V$

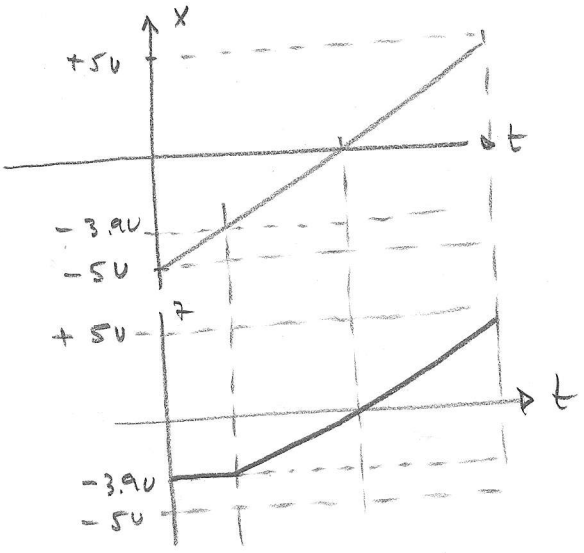
$\boxed{Z = -3.9V}$

meja med a) in b)

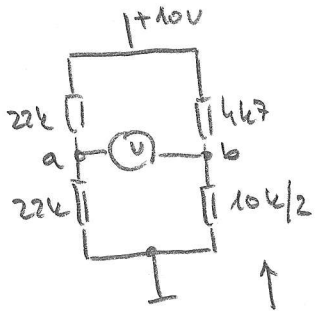
$X = U_R - U_D + U_{ZD}$; $U_D \geq 0,6V \Rightarrow U_{ZD} = -3V3$
prevaja

$X > 0 - 0.6 - 3V3$ $\leftarrow$ takrat je

$X > -3,9V$



Z sledi X za $\underline{X > -3,9V}$

② 

$R_{VM} \to \infty \Rightarrow$ ne upoštevaj

$a = 10V/2 = 5V$

$b = 10V \dfrac{10k/2}{10k/2 + 4700} = 5{,}155V$

↑ srednja lega

VM kaže $a - b = 5V - 5{,}155V$

$= 154{,}6\,mV$

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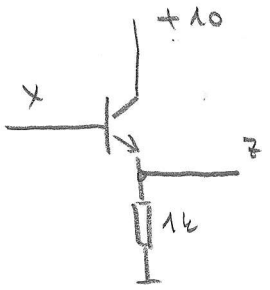
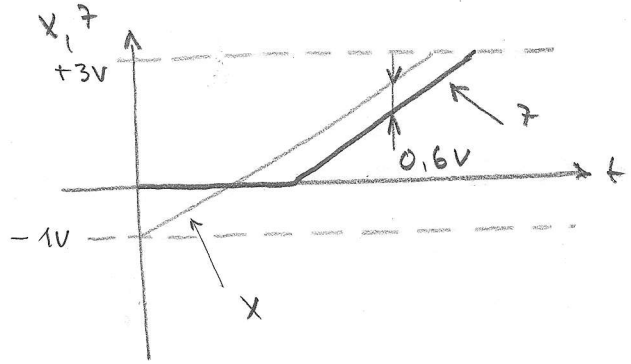
③ 

emitorski sledilnik: $z = x - 0{,}6$

$= x - U_{BE}$

in

zaradi tranzistorja $\Rightarrow z \geq 0$



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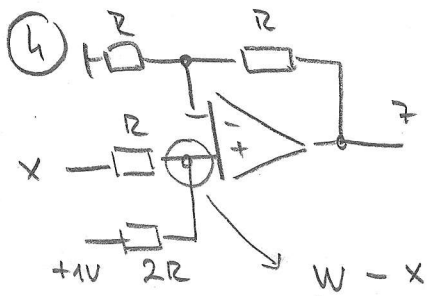
④ 

$$\frac{w - x}{R} + \frac{w - 1V}{2R} = 0$$

$$2w - 2x + w - 1V = 0$$

$$3w = 1 + 2x$$

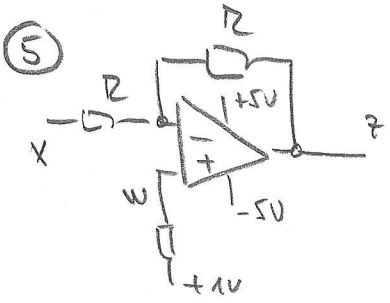
$$w = \frac{1 + 2x}{3}$$

$z = w\left(1 + \frac{R}{R}\right) = 2w$

torej: če je $w < 0 \Rightarrow z < 0$

$2x = 3w - 1 \Rightarrow x = \dfrac{3w - 1}{2} \Rightarrow$ **$x < -\frac{1}{2} \Rightarrow z < 0$**

⑤

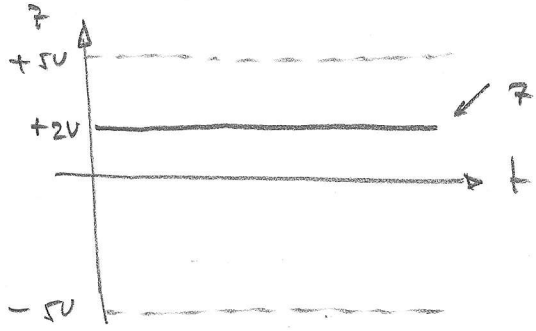


idealni OP: $I_B = 0 \Rightarrow \underline{W = +1V}$

vozl. enačba za neinv. vhod

$$\frac{W-X}{R} + \frac{W-Z}{R} = 0$$

$$Z = 2W - X = \underline{\underline{2V - X}}$$

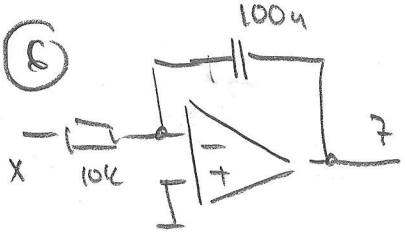


od +2V gre Z lahko le še za 3V navzgor (ali 7V navzdol), torej je največja amplituda izh. signala 3V

ker je ojačenje vrtja enako -1, je torej amplituda vhodnega signala lahko največ $\underline{\underline{3V}}$

---

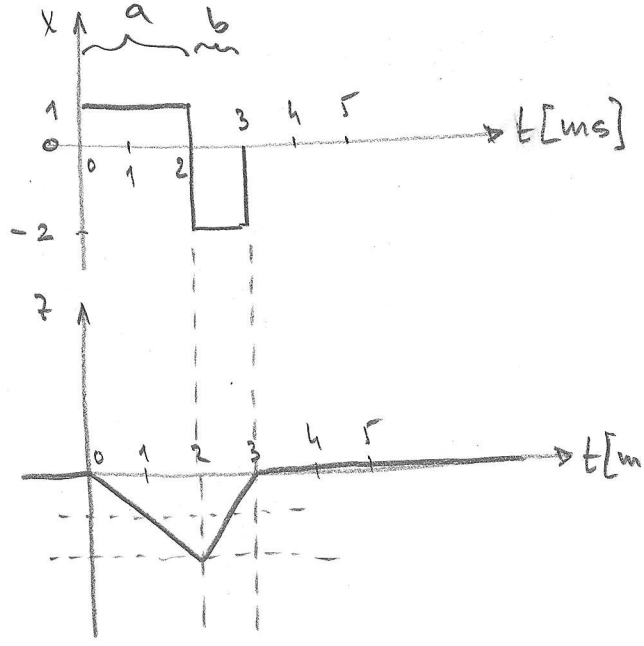
⑥



vezje je integrator z idealnim OP

$$Z = -\frac{1}{RC}\int x(t)\,dt \quad ; RC = 10^4 \cdot 10^{-7} = 10^{-3}\,s$$

začetna vrednost izh. signala je nič



a) vh. napetost je + in konstantna zato izh. napetost enakomerno pada

$$Z = -10^3 \cdot 1 \cdot t$$ } v 2ms pride do $-2V$

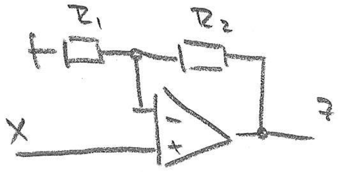
b) vh. napetost je − in konstantna, zato bo izh. napetost enakomerno naraščala

$$Z = -10^3 \cdot (-2) \cdot t$$ } v 1ms se vrne za $2V$

(7)

$$14dB = 20 \cdot \log \frac{Z}{X} = 20 \cdot \log(\text{ojačenje})$$

$$\log(\text{ojačenje}) = \frac{14}{20} \Rightarrow \text{ojačenje} = 10^{14/20} = 5$$

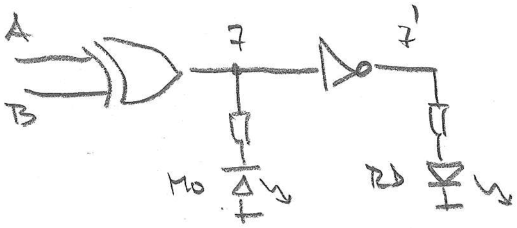


$$G = 1 + \frac{R_2}{R_1} = 5 \Rightarrow R_2 = 4R_1$$

na primer $R_1 = 10k$, $R_2 = 40k$

---

(8)



ugotovitev: modra LED ne more svetiti, ne glede na vrednost signala $Z = \{0, 1\}$

$$Z' = \bar{Z} = \overline{A \oplus B}$$

AB	XOR	$\overline{XOR}$
0 0	0	1
0 1	1	0
1 0	1	0
1 1	0	1

rdeča LED sveti za $Z' = \overline{XOR} = 1$

— ıı — sveti za AB ali $\bar{A}\bar{B}$

---

(9)

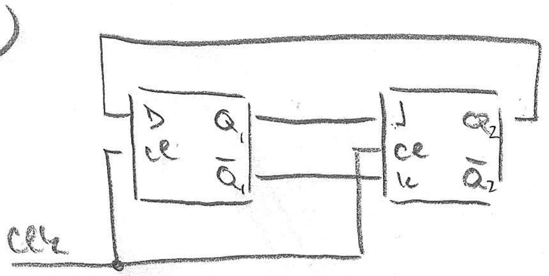
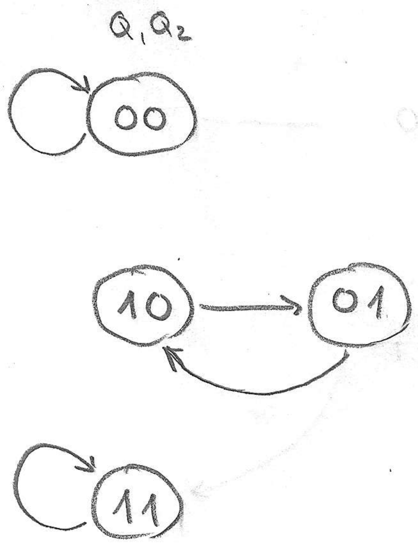


tabela za JK

JK	Q^+
0 0	Q
0 1	0
1 0	1
1 1	$\bar{Q}$

tile kombinaciji sta edino možni

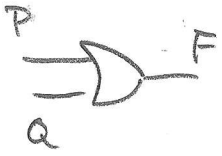


(10) $(P+\overline{P})\cdot(P+Q\overline{P}+Q+PQ) = P+Q = F$

$P+\overline{P} = 1$

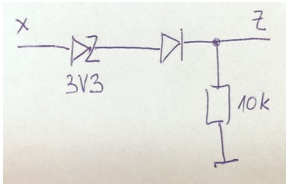
$P(1+Q) \Rightarrow P$

$Q(\overline{P}+1) \Rightarrow Q$

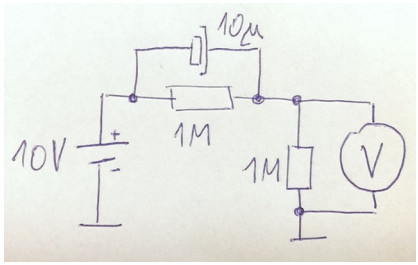


3. pismeni izpit iz Elektronike (FMT)
11. september 2017

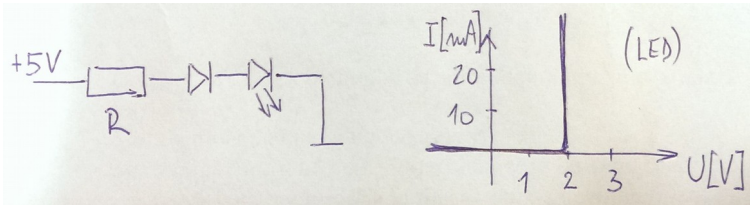
1. Narišite graf z odvisnostjo izhodne napetosti *z* od vhodne napetosti *x*, za vrednosti *x* med -5V in 5V.



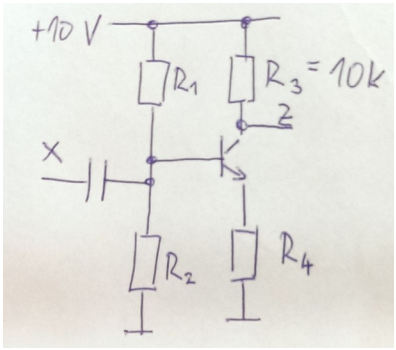
2. Koliko pokaže narisani merilnik napetosti z notranjo upornostjo 10MΩ?



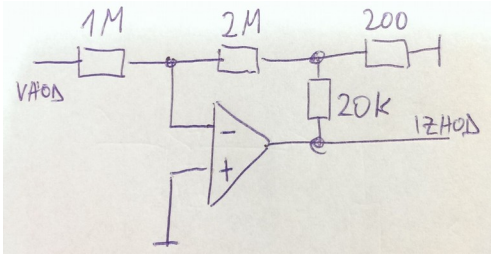
3. Izračunajte vrednost *R*, pri kateri skozi LED teče 20mA. Priložena je karakteristika LED.



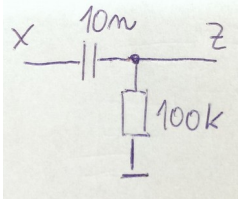
4. Izberite vrednosti upornikov tako, da bo velikost ojačenja 5 in delovna točka izhoda pri 5V. Poraba vezja naj ne bo večja od 2mA.



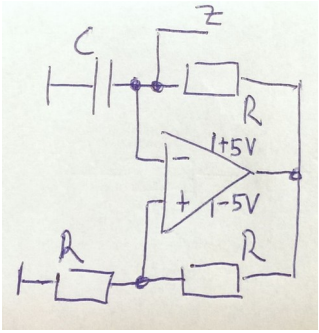
5. Kolikšno je ojačenje narisanega ojačevalnika?



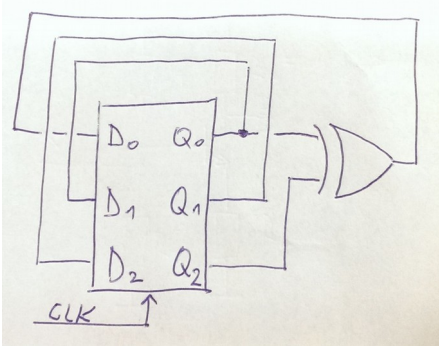
6. Pri kateri frekvenci je ojačenje naslednjega vezja ena desetina ojačenja pri 1MHz?



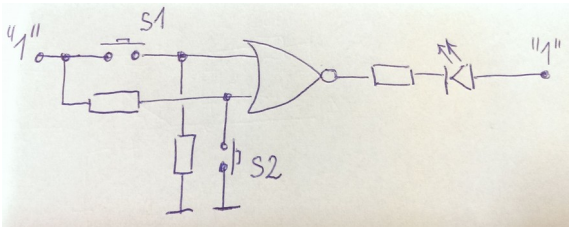
7. Narišite potek izhodnega signala *z* za časovni interval 4*RC*.



8. Narišite diagram stanj $Q_2Q_1Q_0$ za tale avtomat.



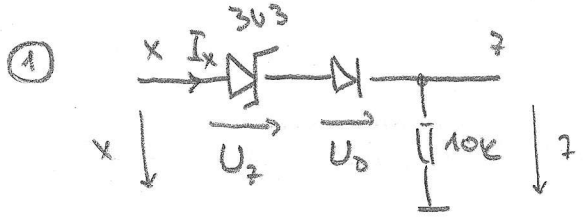
9. Pri katerih stanjih stikal S1 in S2 dioda sveti?



10. S Karnaughovim diagramom poiščite optimizirano rešitev za funkcijo *Z*(*A*,*B*,*C*,*D*). *Z* naj bo 1 za *A*,*B*,*C*,*D* = 0000, 0001, 0100, 0101, 0110, 1110, 1010. *Z* je lahko karkoli za 0111, 1111, 0010. V ostalih primerih mora biti *Z*=0.
Dopisali smo na licu mesta zahtevo, naj bo globina realizacije največ 3.

Časa za reševanje je 60 minut, zapiskov ne uporabljamo. Srečno! M.V.

3. pismi izpit FMT 11.9.2017

① 

a) dioda D ne prevaja, $I_x = 0$

$U_D < 0.6V$ in hkrati $\} z = 0$

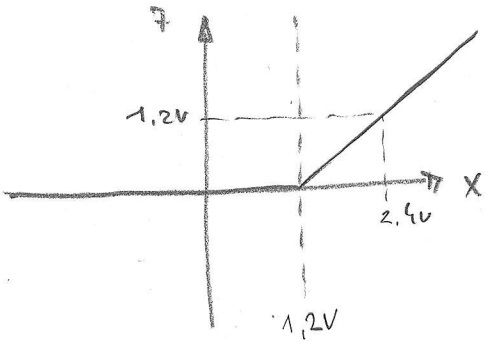
$U_z < 0.6V$

$x = U_z + U_D \Rightarrow x < 1,2V$

b) dioda D prevaja

$x > U_z + U_D = 0.6V + 0.6V$

$= 1.2V$



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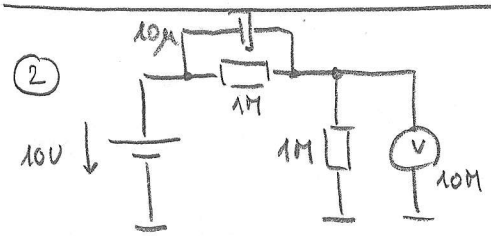
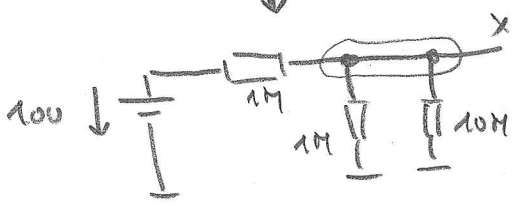
② 

merimo DC, saj je vir DC

⇓

kondenzator ne vpliva

⇓



$$\frac{x-10V}{1M} + \frac{x}{1M} + \frac{x}{10M} = 0$$

$$10x - 100V + 10x + x = 0$$

$$21x = 100V \Rightarrow \underline{x = 4,762V}$$

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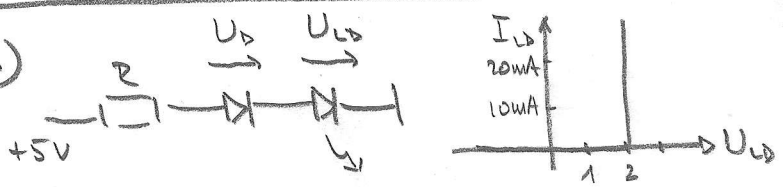
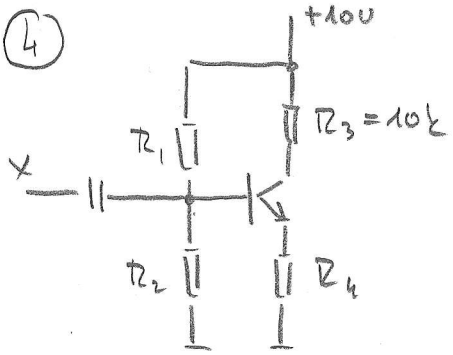
③ 

Iz diagrama je razvidno, da je tokrat, ko LED sveti (prevaja), na njej 2V. Če teče tok skozi LED, teče tudi skozi običajno diodo, kjer je $U_D = 0,6V$.

velja $I_{LD} = I_D = I_R = \dfrac{+5V - U_D - U_{LD}}{R} \Rightarrow R = \dfrac{2,4V}{0,02A} = \underline{120\,\Omega}$

$\underline{R = 120\,\Omega}$

(4)



zahteva: $G = 5 = \frac{R_3}{R_4} \Rightarrow R_4 = \frac{10k}{5} = \underline{\underline{2k}}$

zahteva: delovna točka $U_c = 5V$

$$I_c = \frac{U_{R3}}{R_3} = \frac{10V - 5V}{10k} = \underline{\underline{0.5mA}}$$

iz tega: $U_{R4} = I_{R4} \cdot R_4 = I_c \cdot R_4$

$= 0.5mA \cdot 2k = \underline{\underline{1V}}$

tako je napetost na bazi $U_B = U_{R4} + U_{BE} = \underline{\underline{1.6V}}$

tako napetost mora zagotavljati delilnik R_1, R_2

ker teče v bazo tok $I_B = I_E/\beta \doteq 0.5mA/100 = 5\mu A$

ta delilnik zagotavljal pravo napetost 1.6V (brez upoštevanja toka v bazo) takrat, ko bo skozenj tekel bistveno večji (recimo 5x) tok, kot teče v baza.

Torej: $I_{R2} = 5 \cdot I_B = 25\mu A$

Tako: $R_2 = \frac{U_{R2}}{I_{R2}} = \frac{U_B}{I_{R2}} = \frac{1.6V}{25\mu A} = 64k\Omega$

In še $R_1 = \frac{U_{R1}}{I_{R1}} \doteq \frac{10V - U_B}{I_{R2}} = \frac{8.4V}{25\mu A} = 336k\Omega$

Izberemo upornike iz lestvice

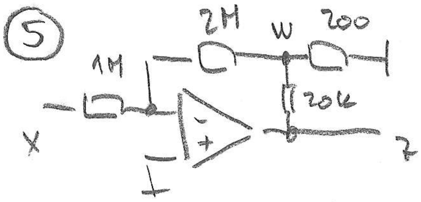
$R_3 = 10k$
$R_4 = 2k$
$R_2 = 68k$
$R_1 = 330k$

poraba $\sim \underline{I_E + I_{R2}}$

$\underline{\underline{< 1mA}}$

(OK)

(5)



idealni OP : $A \to \infty$

$U_{INV.\,VH} = 0$

$$\frac{x}{1M} + \frac{w}{2M} = 0 \Rightarrow \underline{w = -2x}$$

$$\frac{w}{2M} + \frac{w}{200} + \frac{w-z}{20k} = 0$$

$2M \gg 20k$ zanemari 1. člen

$$w \cdot 20k + w \cdot 200 = z \cdot 200$$

$$101 w = z \Rightarrow \boxed{z = -202x}$$

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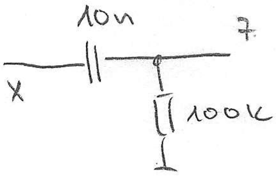
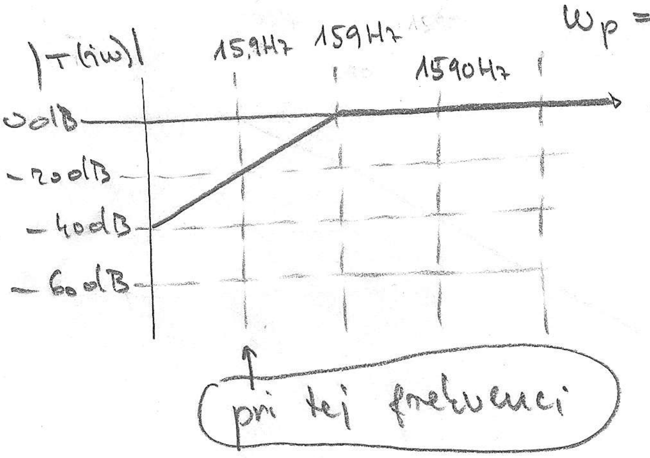
(6)



$$T(i\omega) = \frac{i\omega\tau}{1 + i\omega\tau} \quad ; \tau = 10 \cdot 10^{-9} \cdot 100 \cdot 10^{3} = 10^{-3} = 1ms$$

$$\omega_p = \frac{1}{\tau} \Rightarrow f_p = \frac{1}{2\pi\tau} = \frac{10^3}{2\pi} = \underline{\underline{159Hz}}$$



$$|T(i\omega)| = \frac{\omega\tau}{\sqrt{1 + \omega^2\tau^2}}$$

z glavo skozi zid računanje : $$|T(i\omega)|_{1MHz} = \frac{2\pi \cdot 10^6 \cdot 10^{-3}}{\sqrt{1 + (2\pi \cdot 10^6 \cdot 10^{-3})^2}} = \underline{1}$$

tole tukaj iščemo

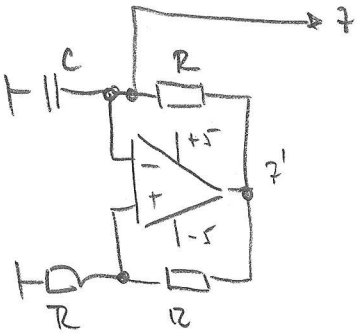
$$|T(i\omega)|_{f_x} = \frac{1}{10} = \frac{2\pi f_x \cdot 10^{-3}}{\sqrt{1 + (2\pi f_x 10^{-3})^2}}$$

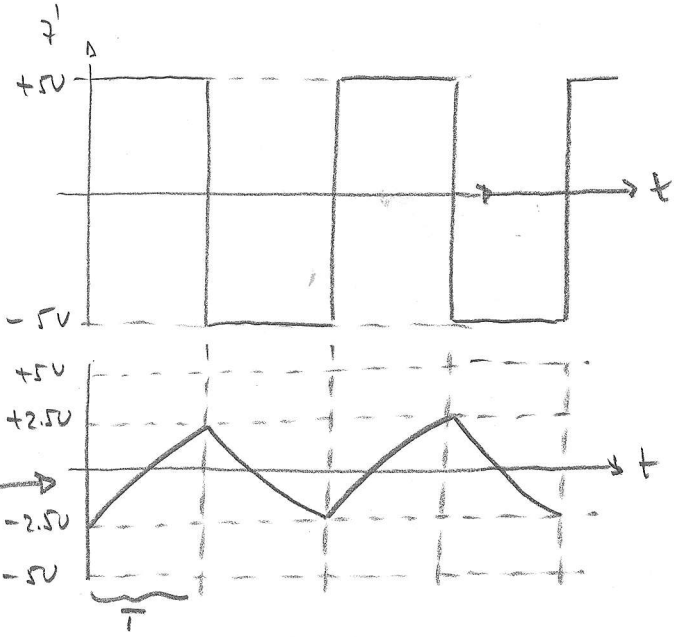
$$1 + 4\pi^2 f_x^2 10^{-6} = (10 \cdot 2\pi f_x \cdot 10^{-3})^2 \quad ; \alpha = 2\pi \cdot 10^{-3} = 6{,}283 \cdot 10^{-3}$$

$$1 + \alpha^2 f_x^2 - 100\alpha^2 f_x^2 = 0$$

$$99\alpha^2 f_x^2 = 1 \Rightarrow f_x = \frac{1}{\alpha \cdot \sqrt{99}} = \underline{\underline{16Hz}}$$

(7)





$$U_c = \frac{3}{2} \cdot 5 \left(1 - e^{-t/\tau}\right)$$

$$\Downarrow$$

$$5 = \frac{3}{2} \cdot 5 \left(1 - e^{-T/\tau}\right)$$

$$\ln \frac{2}{3} = -T/\tau \Rightarrow T = \tau \cdot \ln \frac{3}{2} = \underline{0{,}405\tau}$$

Zato: naloga zahteva risanje diagrama do časa 4τ, ena polperioda traja $0{,}405\tau$, torej bi moral narisati $4\tau / 0{,}405\tau$ polperiod = 9,87 polperiod

menjamem, da je bila naloga ocenjena dobro tudi pri krajšem diagramu

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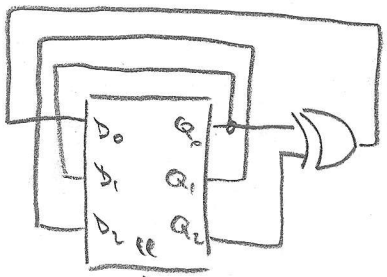
(8)



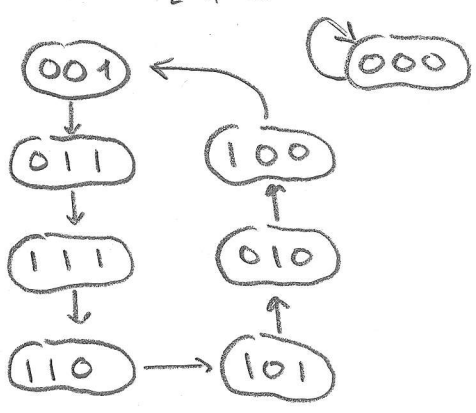
$D_0 = Q_0 \oplus Q_2$, $D_1 = Q_0$, $D_2 = Q_1$

pomik k višjim bitom

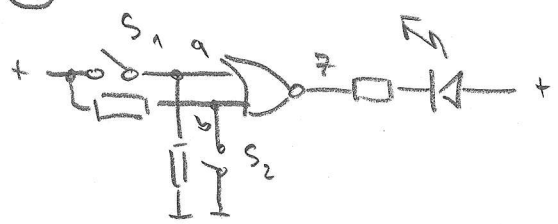
XOR v LSB

$Q_2\,Q_1\,Q_0$	$D_2\,D_1\,D_0$
0 0 0	0 0 0
0 0 1	0 1 1
0 1 0	1 0 0
0 1 1	1 1 1
1 0 0	0 0 1
1 0 1	0 1 0
1 1 0	1 0 1
1 1 1	1 1 0

$Q_2 Q_1 Q_0$



(9)



sveti : $7 = 0$

S_1	S_0	a	b	7	
0	0	0	1	0	sveti
0	1	0	0	1	
1	0	1	1	0	sveti
1	1	1	0	0	sveti

LED ne sveti, če zamenš S_0 in pustiš S_1 odprt

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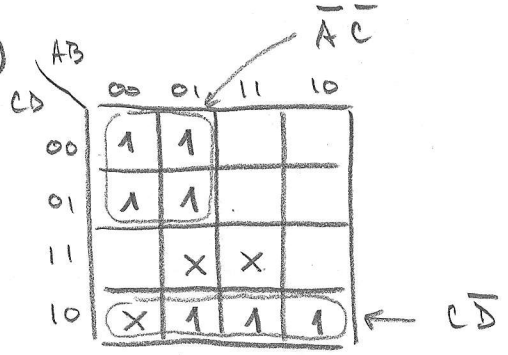
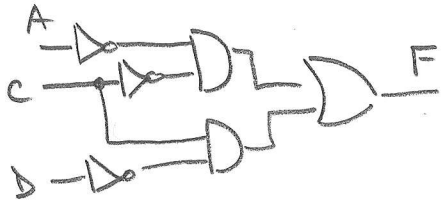
(10)

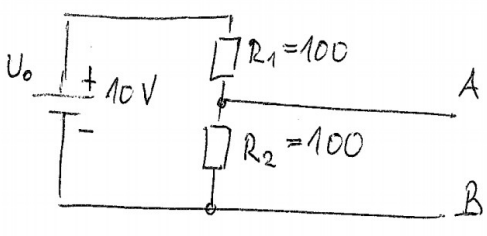


$F = \bar{A}\bar{C} + C\bar{D}$

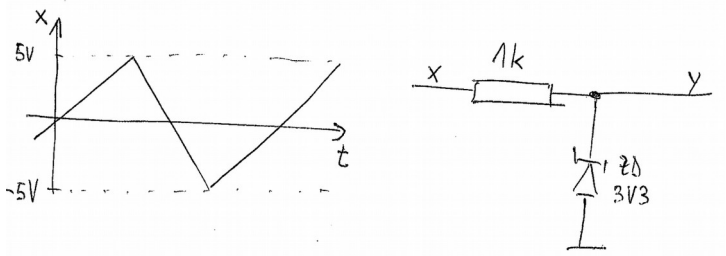


1. kolokvij iz Elektronike (FMT)
7. april 2017

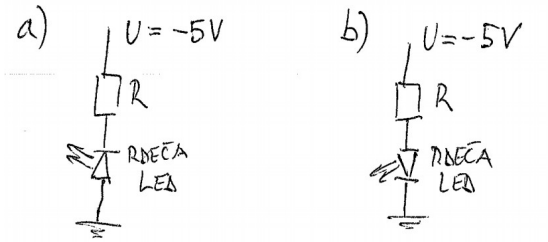
1. Narisano vezje obremenimo med točkama *A* in *B* z dodatnim bremenom R_{BR}. Za primere, ko je R_{BR} enak 10kΩ, 500Ω oz. 1Ω, izračunajte oz. ocenite, za koliko se zmanjša napetost med *A* in *B* ter kolikšna moč se troši na vsakem od R_1, R_2, R_{BR}. (2 točki)



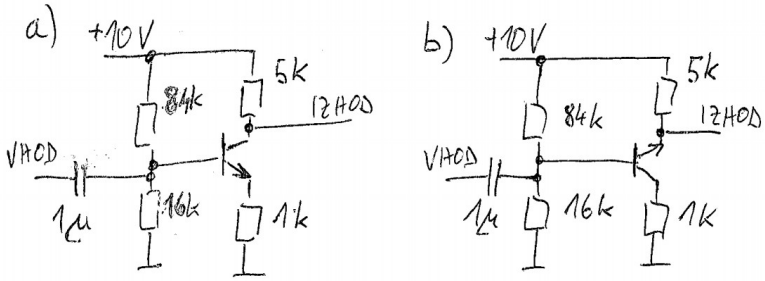
2. Podan je potek vhodnega signala *x*, narišite potek izhoda *y*.



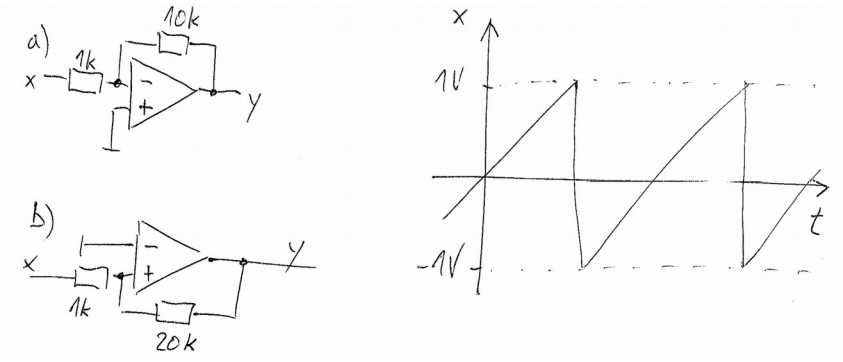
3. Za vsako od obeh vezij navedite primerno vrednost upornika *R*, da bo skozi diodo tekel tok 20mA.



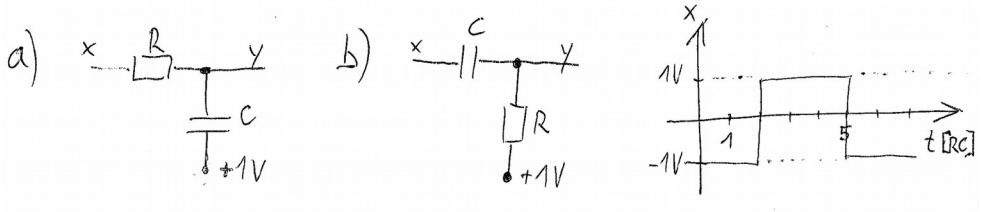
4. Kolikšno je ojačenje vsakega od obeh vezij?



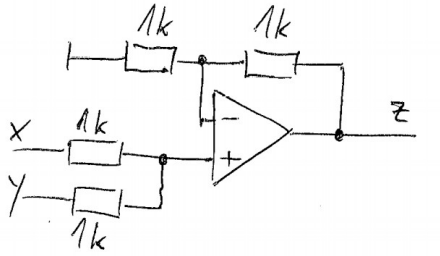
5. Na vhoda obeh narisanih vezij priključimo narisani signal $x(t)$. Narišite potek izhodnega signala $y(t)$ za obe vezji. Napajanje je +12V in -12V.



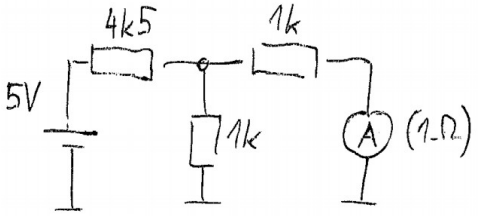
6. Tudi tu na vhoda obeh narisanih vezij priključimo narisani signal $x(t)$. Narišite potek izhodnega signala y za oba primera.



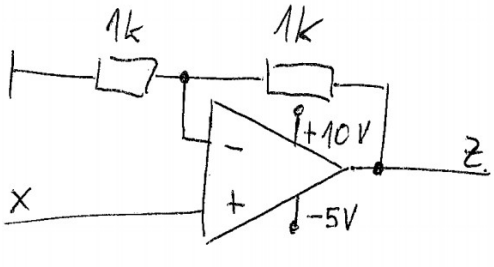
7. Kakšna je funkcijska odvisnost izhodnega signala z od vhodnih x in y?



8. Koliko v tej vezavi pokaže merilnik toka z notranjo upornostjo 1Ω?



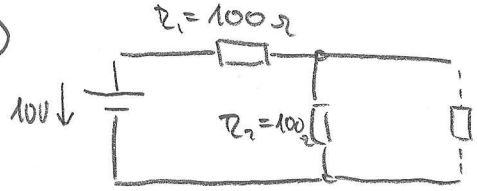
9. V narisani ojačevalnik pripeljemo vhodni signal $x = 4\text{V}\sin(2\pi/\text{s} \cdot t)$. Narišite popono označen graf za dve periodi pripadajočega izhodnega signala z.



Časa za reševanje je 60 minut, zapiskov ne uporabljamo. Srečno! M.V.

1. kolokvij elektronika, FMT, 7.4.2017

(1)



$R_{BR} = 10k$: tok skozi R_{BR} je zanemarljiv proti toku skozi R_2, zato

$$U_{AB} = 10V \cdot \frac{100}{100+100} = \underline{\underline{5V}}$$

$$P_{R2} = P_{R1} = I_{R1} \cdot U_{R1} = \frac{U_{R1}^2}{R_1} = \frac{25V^2 \cdot A}{100\,\Omega} = \underline{\underline{0{,}25W}}$$

$$P_{RB} = 0$$

$R_{BR} = 500\,\Omega$: ni potrebno zanemarjati, tokovi so že primerljivi

$$\frac{U_{AB} - 10V}{R_1} + \frac{U_{AB}}{R_2} + \frac{U_{AB}}{R_{BR}} = 0$$

$$5U_{AB} - 50V + 5U_{AB} + U_{AB} = 0$$

$$11\,U_{AB} = 50V \Rightarrow U_{AB} = \underline{\underline{4{,}545V}}$$

$$\Delta U_{AB} \doteq 0{,}45V$$

$$P_{R1} = \frac{U_{R1}^2}{R_1} = \frac{5{,}45^2}{100} = 297\,mW$$

$$P_{R2} = \frac{U_{R2}^2}{R_2} = \frac{4.54^2}{100} = 206\,mW$$

$$P_{BR} = \frac{U_{BR}^2}{R_{BR}} = \frac{4.54^2}{500} = 41{,}2mW$$

$R_{BR} = 1\,\Omega$: tok skozi R_{BR} >> toka skozi R_2 zanemari R_2

$$U_{AB} = 10V \cdot \frac{1}{1+100} = 99mV$$

$$P_{R1} = \frac{U_{R1}^2}{R_1} = \frac{9,9^2}{100} = 980mW$$

$$P_{R2} = 0\ mW$$

$$P_{RB} = \frac{U_{AB}^2}{R_{BR}} = \frac{0,099^2}{1} = 9,8mW$$

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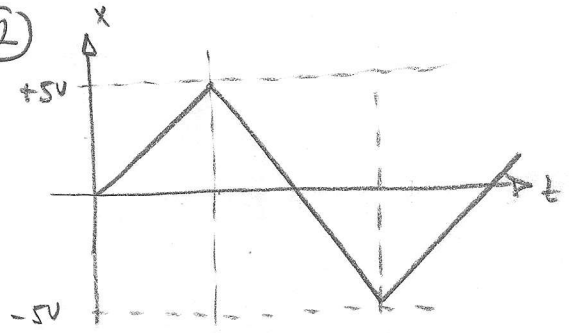
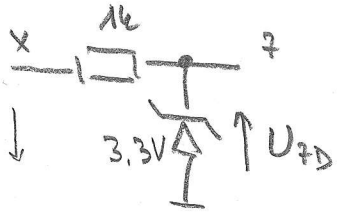
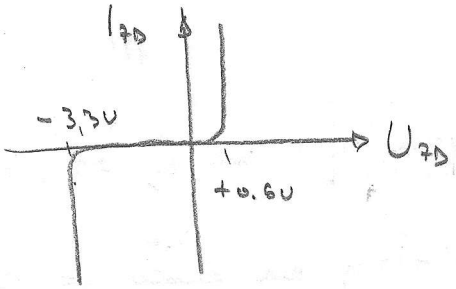
②







- dioda ZD ne prevaja kadar velja

$-3,3V < U_{ZD} < +0.6V$

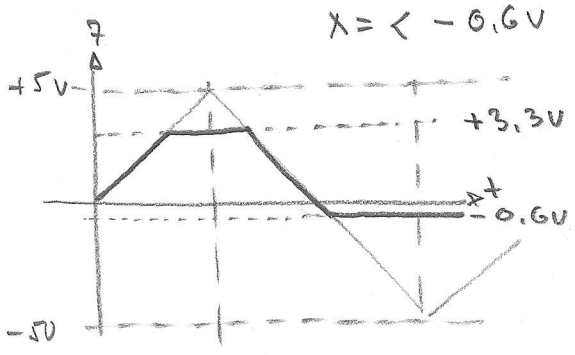
takrat kot skozenjo ne teče, zato mi padca napetosti na R_{1k} in $z = x$

- ko je $U_{ZD} < -3,3V$, ZD prevaja, na njej je zaradi vezja napetost največ $-3,3V$

$$x + U_{ZD} = 0 \Rightarrow x = -U_{ZD} \Rightarrow x > 3,3V$$

- ko je napetost $U_{ZD} > 0,6V$, ZD prevaja, ne nje je zaradi vezja napetost največ $+0.6V$

$$x =< -0,6V$$



③

tok lahko teče, dioda polarizirana v prevodni smeri, na njej je napetost 1,6 V

tok: $I = \frac{U_R}{R} = \frac{-5V + 1.6V}{R} \Rightarrow R = \frac{-3.4V}{-0.02A} = \underline{\underline{170\,\Omega}}$

tok ne more teči, dioda polarizirana v zaporni smeri

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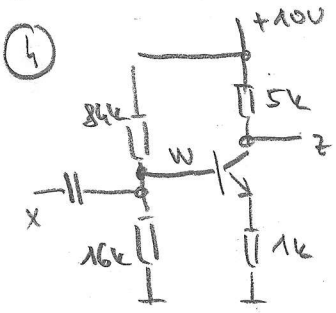
④



$\text{ojačenje} = \frac{R_C}{R_E} = \frac{5k}{1k} = 5$

če je še delovna točka dobro izbrana

poskusimo:

$$W = 10V \frac{16}{16+84} = 1,6V$$

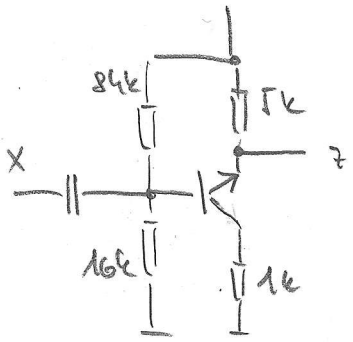
$U_{RE} = W - 0.6V = 1V$

$I_{RE} = U_{RE} / 1k = 1mA$

$U_{RC} = I_{RE} \cdot R_C = 5V$

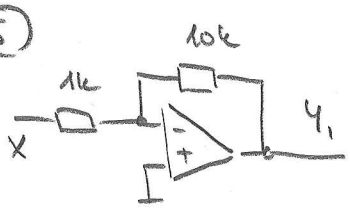
$Z_{DC} = 10V - 5V = 5V$ ✓

na sredi napajanja



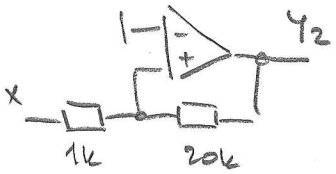
zamenjana priključka emitorja in kolektorja, ojačevalnik ne dela!

⑤



ojačevalnik

$G_1 = -10$

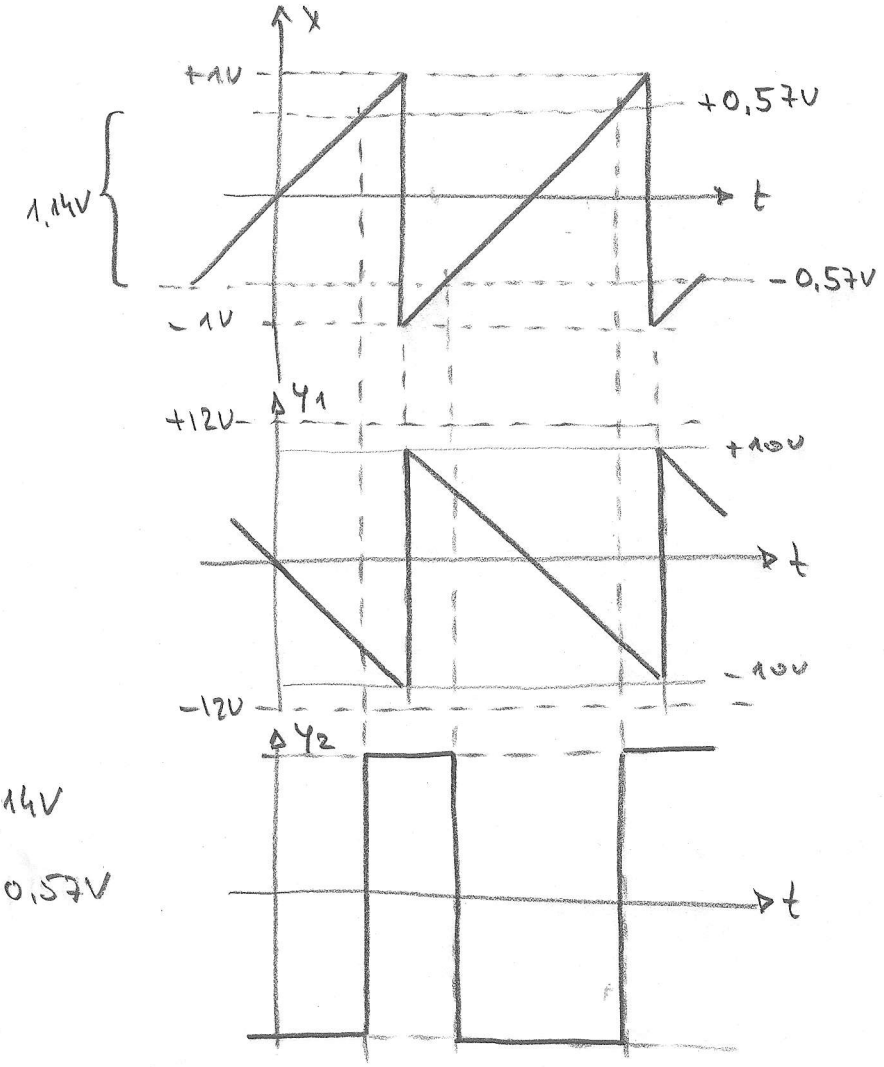


komparator s histerezo

širina zanke je

$2 \cdot 12 \cdot \frac{1}{1+20} = 1{,}14\,V$

prelop pri $0V \pm 0{,}57V$



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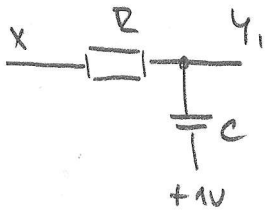
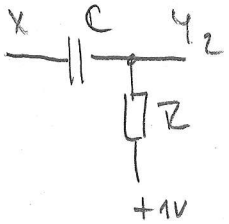
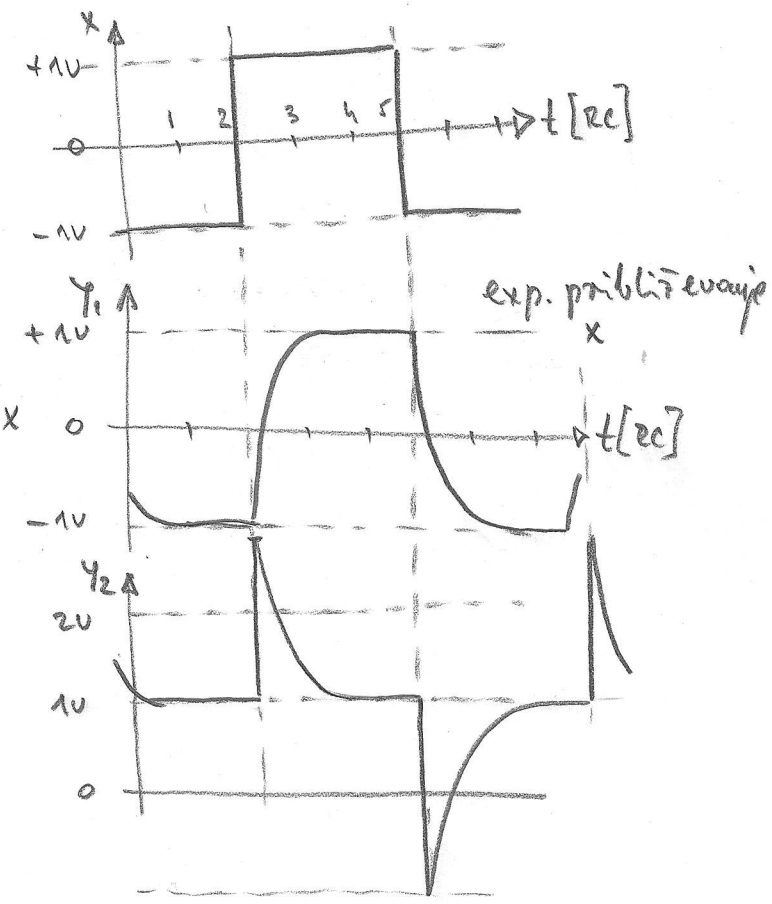
⑥



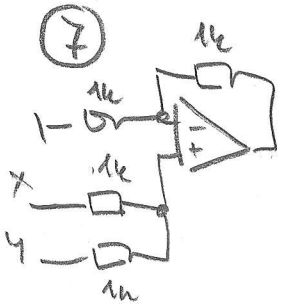
pojav izzveni pred naslednjim preskokom X



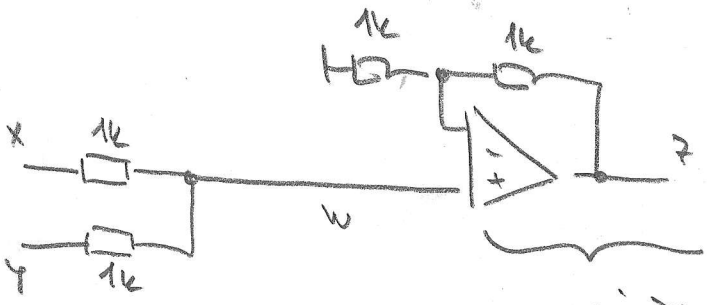
zaznavo pri +1V skačemo za +/- 2V



(7)



idealni OP: $I_B = 0 \Rightarrow$ vzeje je iz obeh delov



ojačevalnik

$$\frac{W-X}{1k} + \frac{W-Y}{1k} = 0$$

$$G = 1 + \frac{1k}{1k} = 2$$

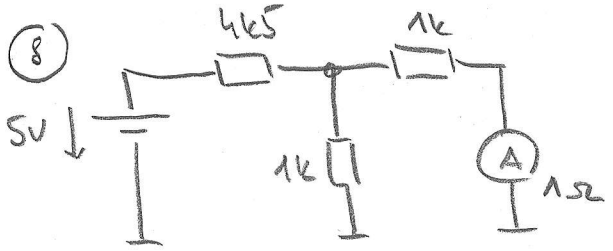
$$2W = X + Y$$

$$W = \frac{X+Y}{2}$$

$$Z = W \cdot 2 = X + Y$$

---

(8)

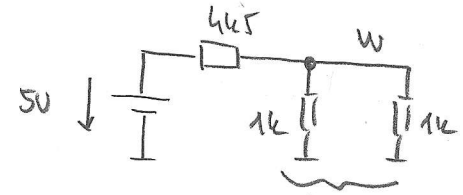


poenostavitve: $R_A \ll 1k$

$\Downarrow$

pri načrtovanju zanemarimo R_A

zato

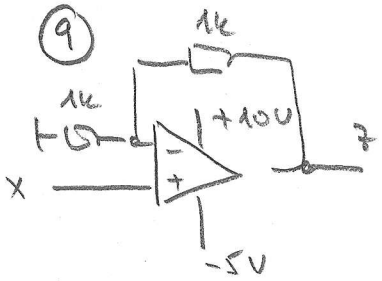


skupaj 500Ω, zato $W = 5V \cdot \frac{500}{500+4500} = \underline{1V}$

pri $W = 1V$ teče skozi $R = 1k$ tok $\underline{1mA}$

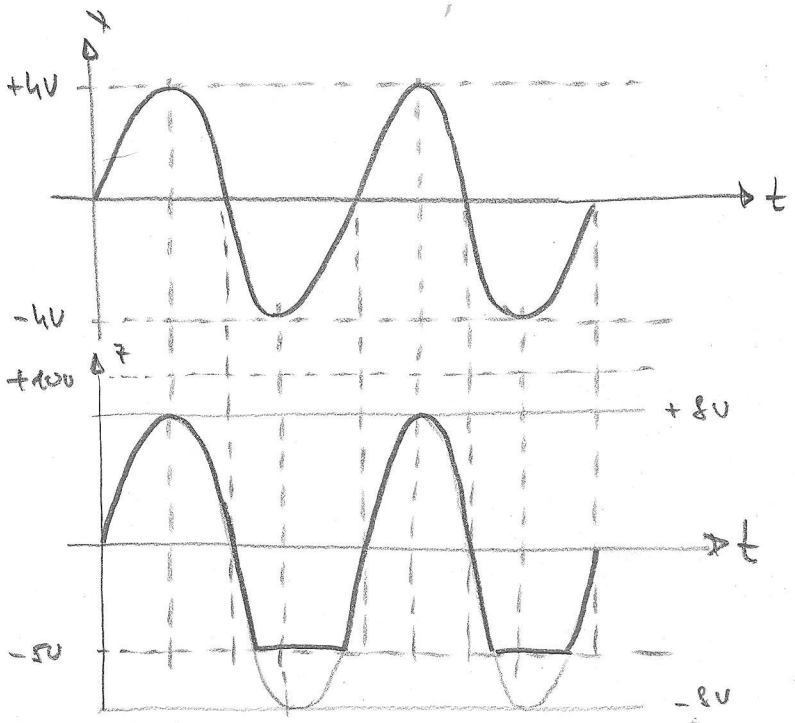
to pokaže A-meter

⑨



neinvertirani ojačevalnik z OP

ojačenje $Q = 1 + \frac{1k}{1k} = 2$

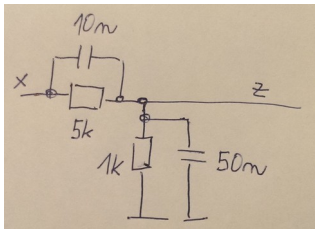


amplituda bi morala biti $4V \cdot 2 = 8V$

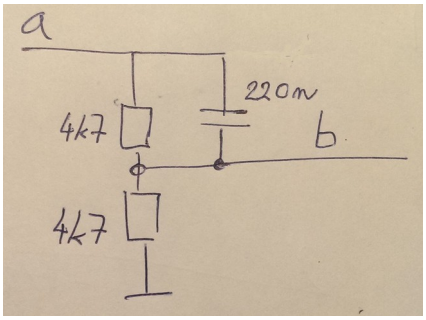
Zaradi napajanj OP to pride na pozitivno stran, na negativni pa je signal porezan pri $-5V$

2. kolokvij iz Elektronike (FMT)
14. junij 2017

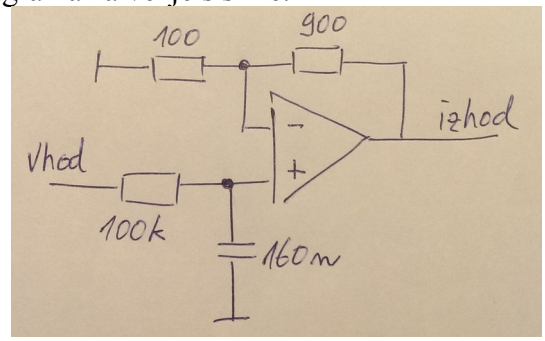
1. Na vhod *x* je priključen sinusni signal. Pri kateri frekvenci je velikost izhodnega signala *z* 1/10 velikosti vhodnega?



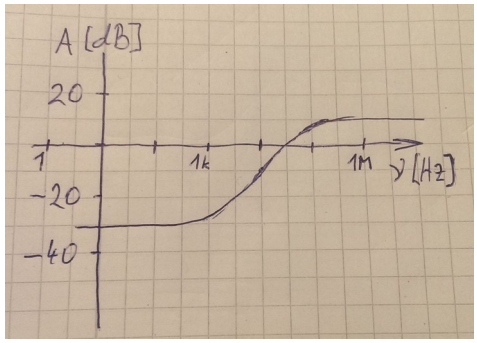
2. Na vhod *a* je priključen sinusni signal. Kolikšno je ojačenje vezja za izhod *b*, v decibelih, pri frekvencah, ki so mnogokrat nižje od 1/*RC* in kolikšno pri frekvencah, ki so mnogokrat višje od 1/*RC*?



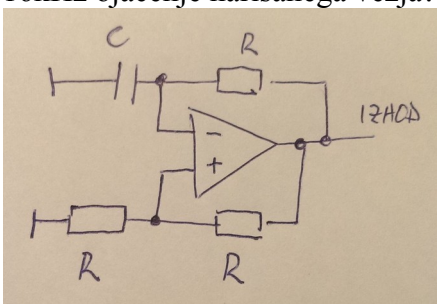
3. Narišite bodejeva diagrama za vezje s slike.



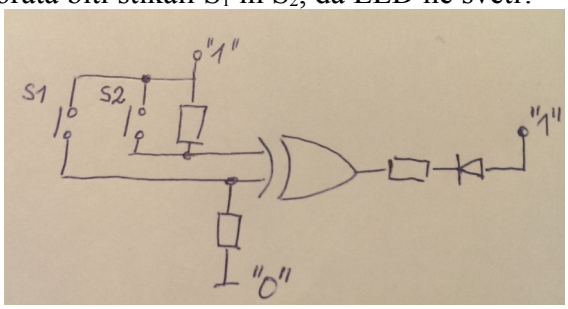
4. Na vhod vezja z narisano ojačevalno karakteristiko je priključen sinusni signal s frekvenco 10kHz in amplitudo 2V. Ocenite amplitudo izhodnega signala.



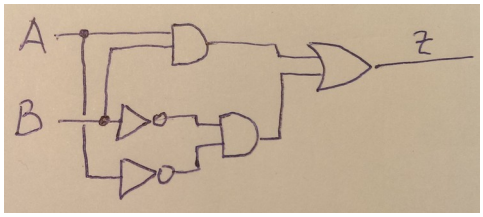
5. Kolikšno je pri frekvenci 16kHz ojačenje narisanega vezja? $2CR = 1\text{kHz}$.



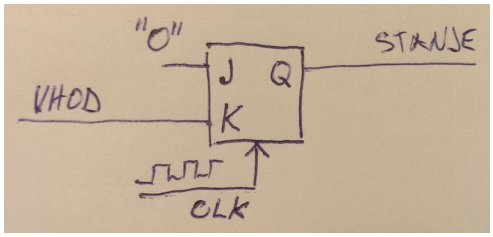
6. V kakšnih stanjih morata biti stikali S_1 in S_2, da LED ne sveti?



7. Zapiši tabelo izhodnih vrednosti *Z*.



8. Narišite popolno označen diagram stanj za narisani avtomat. Plonklistek-tabelo za flip-flop J-K vidite na tabli.

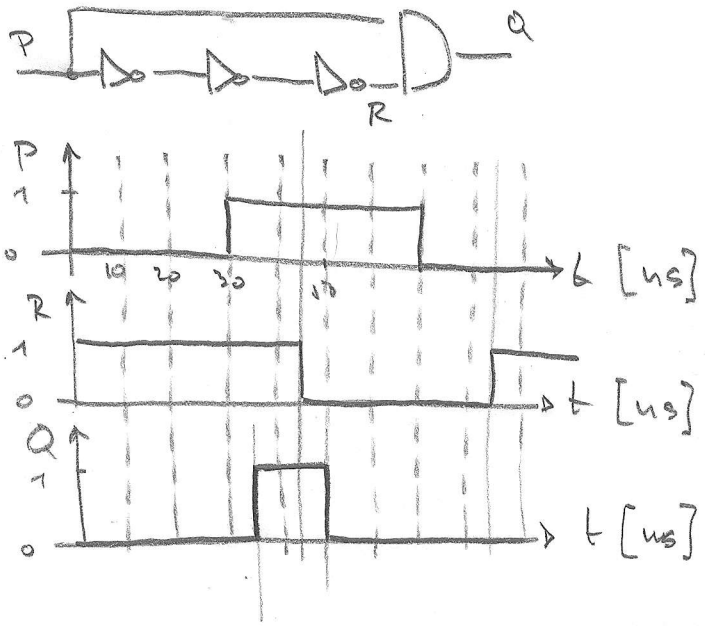


9. Narišite čim manjše vezje, ki implementira naslednjo logično funkcijo: $Z = A\overline{B}+BC+BA$

10. Z najmanjšim možnim multiplekserjem in negacijskimi vrati realizirajte vezje, ki med števili od $000_{(2)}$ do $111_{(2)}$ (torej od nič do sedem) z logično »1« označi natanko tista, ki so deljiva s tri.

Časa za reševanje je 60 minut, zapiskov ne uporabljamo. Srečno! M.V.

2. kolokvij elektronike, FMT, 14. 6. 2017

① 

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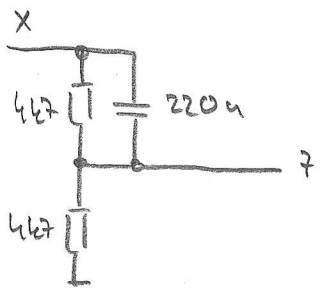
② 

$$\omega_p = \frac{1}{RC} = \frac{1}{4700 \cdot 220 \cdot 10^{-9}} = 970\,Hz$$

$$\omega = \frac{\omega_p}{100} \Rightarrow X_c \gg 4700\,\Omega$$

$\Downarrow$

zanemari X_c

$$G_{min\,\omega} = 20 \log \frac{1}{2} = \underline{-6\,dB}$$

$$\omega = 100\,\omega_p \Rightarrow X_c \ll 4700\,\Omega$$

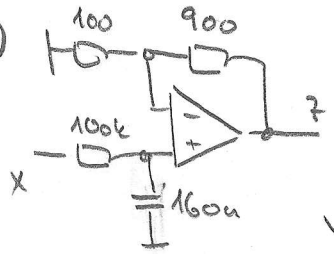
$X_c \equiv$ kratek stik

$\Downarrow$

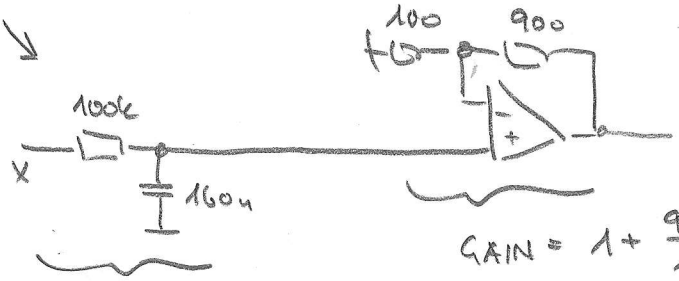
$Z = X$

$$G_{max\,\omega} = 20 \cdot \log 1 = \underline{0\,dB}$$

③



idealni op: nejje iz dveh delov, ki ne vplivata drug na drugega ⇒ obravnavaj ločeno



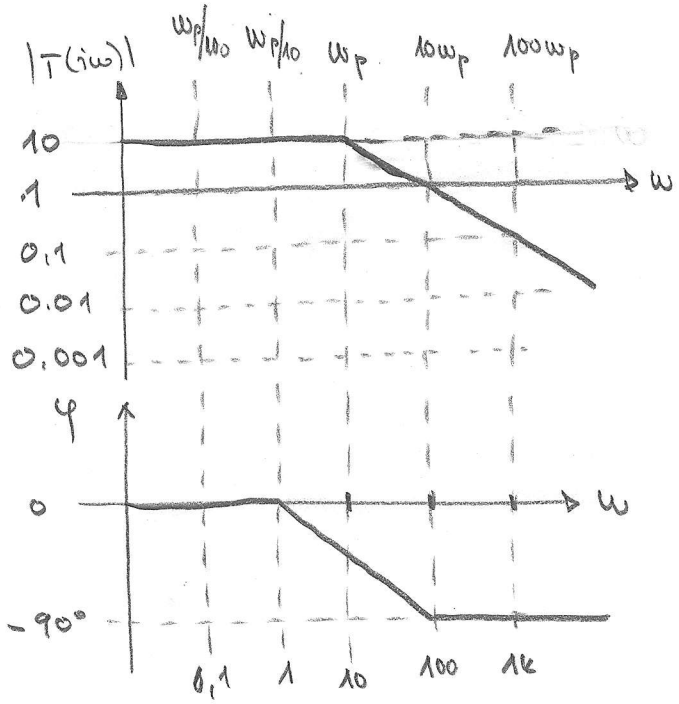
RC-člen

GAIN = $1 + \frac{900}{100} = \underline{\underline{10}}$

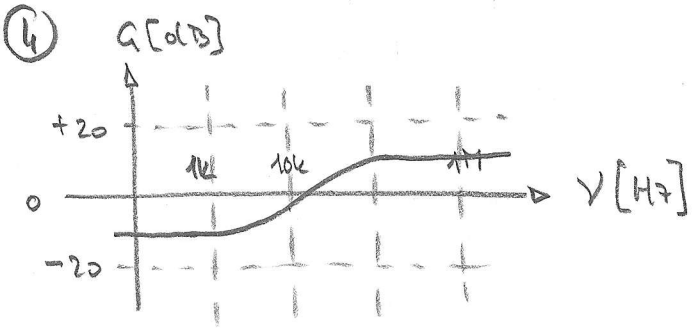
$$T(i\omega) = \frac{1}{1 + i\omega RC}$$

$$\omega_p = \frac{1}{2\pi RC} = \frac{1}{2\pi \, 10^5 \cdot 160 \cdot 10^{-9}}$$

$\omega_p = 10$ Hz



④



$f = 10\ kHz$, ocena ojačenja iz grafa pri $f = 10\ kHz$

$\Rightarrow G = -10\ dB$

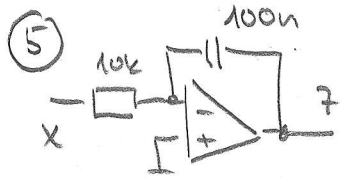
$G[dB] = 20 \cdot \log G \Rightarrow G = 10^{G[dB]/20} = 10^{-10/20} = \underline{0{,}316}$

ampl. izh. signala = ampl. vh. signala × G

$= 2V \times 0.316 = 0{,}632\ V$

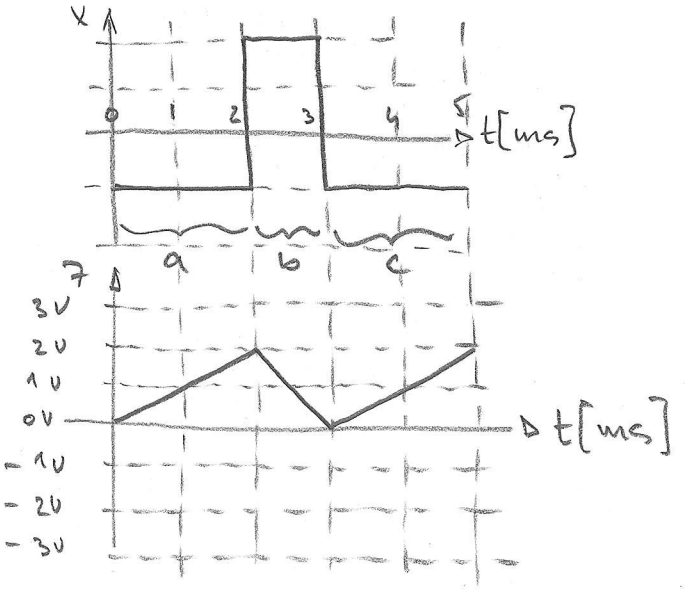
---

⑤



vezje je integrator z idealnim OP

$$Z = -\frac{1}{RC}\int x(t)\,dt$$



ker je x po segmentih konstanten, se v posameznem segmentu z linearno spreminja, v vsakem segmentu začne pri vrednosti, kjer je v prejšnjem segmentu končal

$RC = 10^4 \cdot 10^{-7} = 10^{-3}\ s$

$Z = -10^3 \cdot x \cdot t$

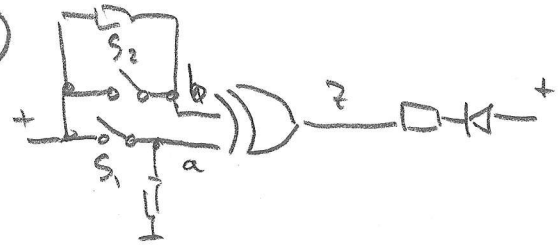
a) neg. x ⇒ naraščajoči Z

1V/ms

b) poz. x ⇒ padajoči Z, -2V/ms

c) neg. x ⇒ naraščajoči Z, 1V/ms

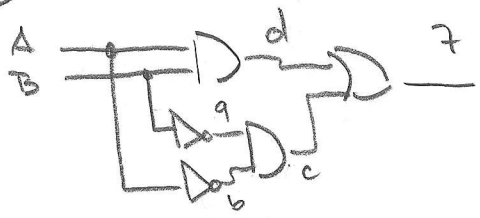
6



ugotoviter: LED sveti b je z=0

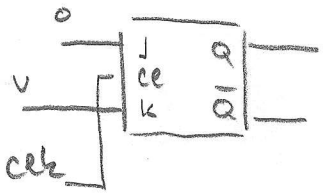
S_1	S_2	a	b	z	
0	0	0	1	1	
0	1	0	1	1	
1	0	1	1	0	⇒ LED sveti za
1	1	1	1	0	like kombinacij

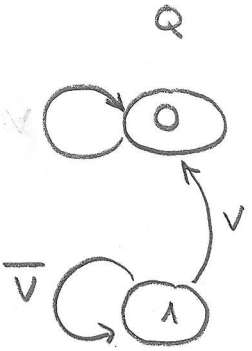
7



A	B	a	b	c	d	z
0	0	1	1	1	0	1
0	1	1	0	0	0	0
1	0	0	1	0	0	0
1	1	0	0	0	1	1

8





J	k	Q^+
0	0	Q
0	1	0
1	0	1
1	1	$\bar{Q}$

spodnji del me ne zanima J = 0

9

$$z = A\bar{B} + BC + BA = A(\bar{B} + B) + BC = A + BC$$

10

2^2	2^1	2^0	delijivo
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0